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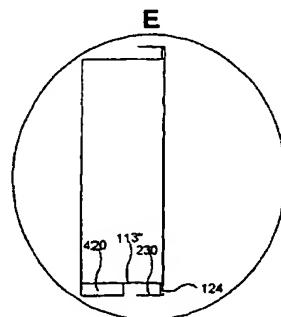
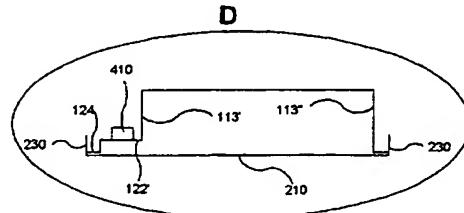
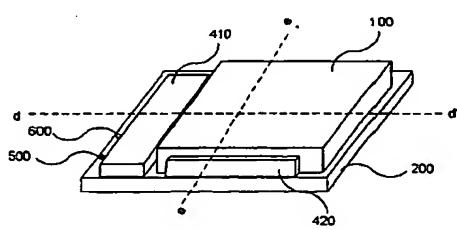
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(54) Title: LITHIUM ION SECONDARY BATTERY



(57) Abstract: Disclosed is a thin and wide lithium ion secondary battery capable of preventing leakage of an electrolyte and enhancing an energy storage density by securing the sealing between a cap and a can. The battery is characterized in that a flange is applied to the can, and an upper portion of the can including the flange is inserted into the cap, assembled, and welded. A welding area necessary for welding the can and the cap is secured to thereby prevent leakage of an electrolyte. A metal container having a wide opening and a thickness of 0.3mm or less can be used as the battery can, which remarkably increases the energy storage density. The can and the cap are assembled by an insertion method, there is no need to use a separate jig during welding of the can and the cap, which enhances productivity and thus decrease production costs.

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LITHIUM ION SECONDARY BATTERY**Technical Field**

The present invention relates to a thin and wide lithium ion secondary battery, and more particularly, to a thin and wide lithium ion secondary battery capable of preventing leakage of an electrolyte, enhancing an energy storage density and making various shapes of batteries by securing the sealing between a cap and a wide area can having a wide opening.

10

Background Art

To meet the growing and diversifying needs of markets for portable electronic products such as mobile phones, camcorders and notebook computers, the demand for a rechargeable battery as a portable power supply is also increasing. As these portable electronic products become smaller and lighter, while providing better performance and multi-functional features, the requirement on the energy storage density of a secondary battery is increasing very rapidly.

Years of research to meet such requirements have yielded the current lithium ion secondary battery, which allows lithium ion to be inserted into and extracted from the host structure of the material reversibly. The lithium ion secondary battery has higher energy density per unit volume as well as per unit weight and increased charge and discharge lifetime compared to the existing aqueous solution type secondary batteries such as Ni-Cd and Ni-MH batteries, and is rapidly replacing existing batteries for portable electronic products.

Meanwhile, the mobile terminals and the personal portable

information terminals have a current tendency in which their display sizes are being increasing due to the increase of process and display information amount, a communication function is added, and energy consumption amount is also rapidly 5 increasing. Accordingly, in case they employ the conventional thin lithium ion secondary battery of less than 6 mm, it is difficult to obtain a sufficient run time. So, two or more batteries are connected or much thicker battery is employed. The appearance of these lithium ion secondary batteries is 10 comprised of a can into which electrolyte is inserted, and a cap forming a closed container together with the can. Then, as the area and capacitance of the lithium ion secondary battery increases, inner pressure is elevated due to the expansion of the electrode and the generation of gas that are naturally 15 generated during the use of the secondary battery, and thus the electrolyte is often leaked at a contact portion of the can and the cap. The leakage of the electrolyte is a fatal influence on the performance of the battery, even contaminates an electronic circuit of the electronic device in which the battery 20 is employed, thereby shortening the life of the high-priced electronic device.

FIGs. 1a and 1b are schematic views for illustrating the conventional lithium ion secondary batteries.

As aforementioned, in order to prevent problems caused 25 by the leakage of the electrolyte, the conventional rectangular shaped lithium ion battery is focused on the minimizing of the closing area of the can and the cap, and uses a metal container of which opening is narrow and deep. Then, if the surface area of the deep-shaped inside increases compared with the area of

the opening of the container, the metal plate should be drawn to be as large as the depth. Accordingly, fracture in the corner of the container or deformation in the wall of the container is caused, it is not proper to fabricate a thin large-area 5 battery. Also, since the container is deeply recessed, there exists a limitation in fabricating various shapes of containers.

Recently, a lithium ion rectangular battery having a wall thickness of 0.2 mm or so is appearing but it has a limitation 10 in appearance material of aluminum having a high drawing rate. Metal having a high drawing rate is easy to perform the deep drawing, but it is easily deformed by an inner pressure of the battery and has a limitation that shows a high welding failure rate in the laser welding used for the sealing owing to high 15 heat conductivity. The deep drawing increases the fabrication costs of the metal appearance material due to the difficulty of the process, and has a large limitation in selecting metal material and changing the thickness.

Meanwhile, the lithium ion secondary battery is 20 fabricated by a process including the steps of forcibly inserting the cap into the can and welding them by a laser beam so as to secure the welding area and enhance the productivity by mass production.

Referring to FIG. 1a, in a conventional lithium ion 25 secondary battery employing the forcibly inserting method, a can should be fabricated in a two steps structure so as to forcibly insert a battery cap 21 into the can, which essentially causes the increase in the thickness of the battery cap 21. And, in case of welding and sealing the metal can 11 and the cap 21

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whose opening is wide and thin, the increase in the thickness of the battery cap 21 is essential so as to secure the sealing quality. Owing to the aforementioned reason, if the thickness of the battery cap 21 increases, loss in the energy density per 5 volume of the battery becomes very large. Accordingly, in order to fabricate a thin large-area battery, it is not proper to employ the forcibly inserting method. As shown in (4) of FIG. 1a, in case a protective circuit box 30 and a PTC box 40 are installed in a state that the can 11 and the cap are assembled, 10 the loss in the energy density per volume becomes much large. Accordingly, there is tried an endeavor in which electrode body is inserted into a metal can whose opening is wide and deep, one stepped structure of plate-shaped metal cap is placed, and the can and the cap are welded and sealed.

15 Referring to FIG. 1b, in case a battery cap 22 having not the forcibly inserting and two stepped shape but one stepped and wide plate shape is used, it is necessary to increase the thickness of the battery can 12 and the battery cap 22 so as to secure a welding area necessary for the welding. Then, since 20 the allowable maximum welding length of the metal container is the same as the thickness of the metal container, the metal container having the thickness of less than 0.3 mm fails to secure a proper sealability, there occurs a drawback in that the production yield is lowered.

25 Also, in case a battery cap 22 having not the forcibly inserting and two stepped shape but one stepped and wide plate shape is used, it is necessary to exactly fit the bonding locations of the battery can 12 and the battery cap 22. This requires controlling the tolerance at a high preciseness, which

increases the production costs, needs a further high-priced automatic jig in the welding process, and dropping the production speed owing to the process time taken in fixing the location to increase the production costs.

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Detailed description of the invention

Accordingly, it is a technical object of the invention to provide a lithium ion secondary battery in which a flange is applied to a batter can to fabricate the can and cap thinner than those of the conventional and thus enhance the energy storage density, to adjust the protruded length of the flange and thus enhance the efficiency of the sealability, and to enhance the productivity.

It is another object of the invention to provide a lithium ion secondary battery in which a space outside the battery can be utilized to a maximum by installing a protective circuit box and a PTC box at the outer space formed by the shape of the can.

To accomplish the above objects and other features, there is provided a lithium ion secondary battery. The lithium ion secondary battery includes: a can including a first region and a second region each having an independent space including a lower portion, an opened upper portion and sidewalls connecting the lower portion with the opened upper portion, and the independent spaces of the first region and the second region communicating with each other, the first region including a closed lower portion such that an electrode plat and an electrolyte are inwardly inserted, the second region including a predetermined region which is closed and protruded outwardly from the sidewall of the first region and a remaining

predetermined region including an opened lower portion which allows the space formed by the first region to communicate with the space formed by the second region, and a flange prepared protruded outwardly from the upper edges of the second region,
5 wherein the second region is larger in cross-sectional area than the first region; a cap including a closed upper portion and sidewalls forming a periphery capable of enclosing the flange and assembled with the can to form a single closed container such that inner sides of the sidewalls of the cap face the outer
10 side of the flange; and an electrode terminal of which one end is connected with the electrode plate and the other end is exposed to the outside of the can.

Here, the lower portion of the second region has a predetermined region that is protruded by a length range of 2 - 10 mm from the sidewall of the first region, and the flange is protruded by a length range of 0.2 - 2 mm from the sidewall of the second region. The periphery of the sidewalls of the cap is formed such that a clearance between the inner side of the sidewalls of the cap and the outer side of the flange is 1 mm or less if the can and the cap are located such that the inner sides of the sidewalls face the outer side of the flange. A height of the sidewall of the second region is in a range of 0.5 mm to 3 mm, and a height of the sidewalls of the cap is in a range of 0.5 mm to 5 mm.

25 Further, it is preferable that the other end of the electrode terminal penetrates the closed lower portion of the second region of the can to be exposed to the outside of the can. Also, a protective circuit box is provided therein with a circuit electrically connected with the electrode terminal,

the protective circuit box being installed at a space formed by the outer side of the one sidewall of the first region and the outer side of the second region. In addition, a PTC box is provided therein with a PTC device electrically connected with
5 the electrode terminals, the PTC box being installed outside the sidewall of the first region of the can or outside the lower portion of the second region of the can such that the PTC box is located at a space formed by an outer side of the sidewall of the first region and an outer side of the lower portion of
10 second region, or installed at the sidewall of the first region such that the PTC box is located below the flange.

Furthermore, the flange of the can is welded with the sidewall or upper side of the cap to form the closed container

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Brief Description of the Drawings

FIGs. 1a and 1b are perspective views illustrating a conventional lithium ion secondary battery; and

20 FIG. 2 through FIG. 5 are perspective views illustrating lithium ion secondary batteries according to the present invention.

Best Mode for Carrying Out the Invention

Hereinafter, there are in detail described preferred embodiments of the present invention with reference to the
25 accompanying drawings. In the drawings, like elements having the same function are designated by identical reference numerals, and their repeated descriptions are intentionally omitted.

Fig. 2 is a perspective view of a can according to the

present invention. In Fig. 2, reference symbol 'A' represents a sectional view taken along the line a-a' of Fig. 2. Fig. 3 is a perspective view of a cap according to the present invention. In Fig. 3, reference symbol 'B' represents a sectional view taken along the line b-b' of Fig. 3. Fig. 4 is a perspective view showing an assembly state in which the can of Fig. 2 is assembled with the cap of Fig. 3. In Fig. 4, reference symbol 'C' represents a sectional view taken along the line c-c' of Fig. 4. Fig. 5 is a perspective view showing a configuration 10 in which a protective circuit box and a PTC box are installed in the assembly of the can and cap shown in Fig. 4. In Fig. 5, reference symbol 'D' represents a sectional view taken along the line d-d' of Fig. 5 and reference symbol 'E' represents a sectional view taken along the line e-e' of Fig. 5.

15 Referring to Fig. 2, a can 100 is divided into a first region 110 and a second region 120 each of which has an independent space and communicating with each other. The second region 120 is larger in cross-sectional area than the first region 110.

20 The first region 110 includes an opened upper portion 111, a closed lower portion 112 and sidewalls 113 connecting the upper portion 111 and the lower portion 112 to form a space.

The second region 120 includes a lower portion 122, an opened upper portion 121, sidewalls 123 connecting the upper portion 121 and the lower portion 122 to form a space, and a flange 124 prepared protruded outwardly from the upper edges of the sidewalls 123. At this time, a predetermined part 122' of the lower portion 122 of the second region 120 is partially closed unlike the lower portion 112 of the first region 110 to

be protruded outwardly and a remaining portion 122" of the lower portion 122 of the second region 120 is opened to be connected with the upper portion 111 of the first region 110. Thus, the space of the first region 110 communicates with the space of 5 the second region 120 through the upper portion of the first region 110 and the lower portion 122 of the second region 120. Meanwhile, it is allowed that the closed and protruded region of the lower portion 122 of the second region 120 is formed only at one sidewall. In this case, in the sidewalls of the second 10 region 120, it is allowed that the remaining sidewalls other than one sidewall 123 are positioned at extending lines of the other sidewalls 113" of the first region 110.

Although not shown in the drawings, electrode plate and electrolyte are placed in the first region 110 of the can 100, 15 and one end of the electrode terminal is connected with the electrode plate while the other end thereof penetrates the lower portion 122' of the protruded and closed lower portion 122' of the second region 120 of the can 100 to be exposed to the outside.

The flange 124 of the can 100 is assembled with a cap to 20 be described later, thereby forming a closed container.

Meanwhile, it is desirous that the length of the closed and protruded region 122' of the lower portion 122 of the second region 120 is 2 - 10 mm when measured from the one sidewall 113' of the first region. This length range is determined by 25 considering the volume and installation workability of a protective box or a PTC box to be described later in case the protective box or the PTC box is installed at a space formed by an outside of the one sidewall 113' of the first region 110 of the can 100 and an outside of the closed and protruded lower

portion 122' of the second region 120. However, if the protruded length increases above the aforementioned range, there occurs a problem in that the volume of the can increases.

The flange 124 enables to increase the efficiency of the sealing by controlling the protruded length. It is preferable that the flange 124 is protruded from the sidewall of the second region 120 by a length range of 0.2 - 2 mm. This length range is determined by considering the workability in the bonding work of the can and the cap to be described later.

Referring to Fig. 3, a cap 200 includes a closed upper portion 210 and sidewalls 230 forming a periphery capable of enclosing the flange 124 of the can 100 of FIG. 2, and is shaped in a structure of which inner lower side is opened. At this time, when the can 100 and the cap 200 are assembled with each other such that the inner sides of the sidewalls 230 of the cap 200 face the outer side of the flange 124 of the can 100 and the upper side of the flange 123 of the can 100 is in contact with an inner selected region of the upper side 210 of the cap 200, it is desirous to form the periphery of the sidewalls 230 of the cap 200 such that a clearance between the inner side of the sidewalls 230 of the cap 200 and the outer side of the flange 124 is 1 mm or less. If the clearance is too large, the sealability may be lowered even though the can 100 and the cap 200 are bonded to each other by a welding process or the like.

And, if the height of the sidewall 123 of the second region 120 of the can 100 is in a range of 0.5 mm to 3 mm, it is desirous that the height of the sidewalls 230 of the cap 200 is in a range of 0.5 mm to 5 mm. This is because in case of assembling the can 100 and the cap 200, it is desirous for the sealability that

the cap 200 at least encloses the first and second regions 110 and 120 of the can 100 but if the height of the cap 200 is too large, the workability in bonding of the can 100 and the cap 200 is lowered.

5 Referring to FIG. 4, the can 100 and the cap are assembled with each other such that the inner sides of the sidewalls 230 of the cap 200 face the outer side of the flange 124, and the upper side of the flange 123 of the can 100 is in contact with an inner selected region of the upper side 210 of the cap 200.

10 10 The sidewalls 230 and the upper side of the cap are bonded with the flange 124 of the can 100 using a laser welding or a resistor welding, so that a closed container is formed.

15 Thus, the upper side of the can including the flange is inserted into the cap, and the flange and the cap are welded, thereby capable of securing a welding area necessary for the welding of the can and the cap and performing the welding without a separate jig.

20 Meanwhile, as a safety device, the lithium ion secondary battery employs a PTC device for shutting off the current or a protective circuit for preventing overcharge or overdischage.

25 Referring to FIG. 5, there is a protective circuit box 410 electrically connected with electrode terminals at a space formed by the outer side of the one sidewall 113' of the first region of the can 100 and the outer side of the protruded and closed lower side 122' of the second region. At this time, the protective circuit box 410 is firmly installed adjacent to the one sidewall 113' of the first region of the can 100 or the lower side 122' of the second region of the can 100.

And, there is installed a PTC box 420 electrically

connected with the electrode terminals at a space formed by an outer side of another sidewall 113" of the first region of the can 100 and the lower side of the flange 124. At this time, the PCT box 420 is firmly installed outside the sidewall 113" of 5 the can 100. Like this, by installing the protective circuit box 410 at the space formed by the outer side of the one sidewall 113' of the first region of the can 100 and the outer side of the protruded and closed lower side 122' of the second region and the PTC box 420 at the space formed by the outer side of 10 another sidewall 113" of the first region of the can 100 and the lower side of the flange 124, the volume of the battery soft pack fabricated with the protective circuit attached thereto decreases and at the same time storage density per volume as the battery soft pack state is enhanced.

15 Meanwhile, there is provided an electrolyte injection hole 600 so as to inject electrolyte through the closed and protruded lower side 122' of the second region. The other end 500 of the electrode terminal whose one end is connected with 20 an electrode plate penetrates the protruded and closed region 122' below the second region of the can 100 to be installed at an outer wall of the lower side 122' of the second region. At this time, a predetermined region below the second region, which the electrode terminal 50 penetrates is very firmly sealed such that the electrolyte is not leaked, and the electrolyte 25 injection hole 600 is very firmly sealed after the electrolyte is injected.

[Embodiment 1]

A rectangular-shaped lithium ion secondary battery with

a thickness of 4.2 mm, a short axis length of 34 mm and a long axis length of 54 mm was fabricated using a can and a cap of the present invention made of a metal plate having a thickness of 0.15 mm.

5 At this time, the flange of the can has a protruded length of 0.5 mm and a spacing between the outer side of the flange of the can and the inner side of the sidewall of the cap is set 0.1 mm so as to provide a sufficient area for welding. The can and the cap are assembled as shown in FIG. 4 and then the flange
10 of the can, and the upper side and the sidewalls of the cap are bonded by a laser welding. And, the protective circuit box and the PTC box are firmly attached to the outside of the can in the shape of FIG. 4.

Thus, the fabricated lithium ion secondary battery has
15 an energy storage density per volume as the soft pack state, of 420 Wh/l.

[Example of the lithium ion secondary battery according to FIG. 1a]

20 A rectangular-shaped lithium ion secondary battery with a thickness of 4.2 mm, a short axis length of 34 mm and a long axis length of 50 mm was fabricated using a can and a cap having the shapes shown in FIG. 1a. At this time, a metal plate with a thickness of 0.3 mm was used for the can and a metal plate
25 with a thickness of 0.8 mm was used for the cap. The prepared can and cap were assembled like (3) of FIG. 1a and were welded by a laser. Then, as shown in (4) of FIG. 1a, a protective circuit box and a PTC box are firmly attached to the outside of the assembly.

Here, the fabricated lithium ion secondary battery has an energy storage density per volume as the soft pack state, of 286 Wh/l.

[Example of the lithium ion secondary battery according
5 to FIG. 1b]

A rectangular-shaped lithium ion secondary battery with a thickness of 4.2 mm, a short axis length of 34 mm and a long axis length of 50 mm was fabricated using a can and a cap having the shapes shown in FIG. 1b. At this time, the can and the cap
10 were prepared in one layer structure using a metal plate with a thickness of 0.3 mm. The prepared can and cap were assembled like (3) of FIG. 1b and were welded by a laser.

[Comparative Example 1]

15 Comparing the first embodiment of the present invention with [Example of the lithium ion secondary battery according to FIG. 1a], it is known that the first embodiment of the present invention is greater in energy storage density per unit volume than [Example of the lithium ion secondary battery according
20 to FIG. 1a]. Accordingly, in case the lithium ion secondary battery according to the present invention is fabricated to have the same energy storage density as [Example of the lithium ion secondary battery according to FIG. 1a], it becomes possible to make the secondary battery of the present invention thinner
25 than the battery of [Example of the lithium ion secondary battery according to FIG. 1a]. Thus, by making the molding depth of the container shallower than the conventional one, it is possible to fabricate batteries having various shapes with ease.

[Comparative 2]

The battery of the present invention according to the aforementioned embodiment 1 and the lithium ion secondary 5 battery fabricated according to FIGs. 1a and 1b were stored for five days in a charge state of 4.2 V. And, holes were respectively made in center portions of the respective batteries. The batteries having the holes were kept for one hour in a state that an air pressure of 5 Hectopascal is applied.

10 In this condition, in the battery according to [Example of the lithium ion secondary battery according to FIG. 1b], a small amount of electrolyte is leaked out and its voltage is lowered to 3.97 V, whereas in both cases of the battery according to [Example of the lithium ion secondary battery according to 15 FIG. 1a] and the battery of the present invention, electrolyte was not leaked and voltages were respectively maintained at 4.12 V and 4.13 V.

Also, the battery according to [Example of the lithium ion secondary battery according to FIG. 1b] needs a total of 20 30 minutes for the welding process and causes a loss of 3 times or more in productivity compared with the battery of the present invention needing only 10 minutes for the welding process. Also, the battery according to [Example of the lithium ion secondary battery according to FIG. 1b] needs a separate welding machine 25 and a jig with a complex shape in which interference is removed but since the battery of the present invention needs only the inserting process for inserting the can into the lower side of the cap, there is no need of the separate jig.

Industrial Applicability

As described previously, according to the lithium ion secondary battery of the present invention, a flange is applied to the can, and the can and the cap are assembled by inserting 5 the upper side of the can including the flange into the cap, so that a welding area necessary for the welding of the can and the cap can be secured to prevent electrolyte from being leaked. A metal container whose opening is wide and shallow can be used as the battery can. It is allowed to reduce the thickness of 10 the metal container below 0.3 mm, thereby remarkably increasing the energy storage density.

In addition, since the can and the cap are assembled in an insertion process, there is no need of a separate jig while welding the can and the cap, thereby capable of enhancing the 15 productivity and thus lowering the production costs.

Further, the protective circuit box and the PTC box can be installed on an outer space formed by the structure of the can, thereby remarkably enhancing the energy storage density per volume of the battery soft pack.

20 While the present invention has been described in detail with reference to the preferred embodiments, those skilled in the art will appreciate that various modifications and substitutions can be made thereto without departing from the spirit and scope of the present invention as set forth in the 25 appended claims.

Claims:

1. A lithium ion secondary battery comprising:
 - a can including a first region and a second region each having an independent space including a lower portion, an opened upper portion and sidewalls connecting the lower portion with the opened upper portion, and the independent spaces of the first region and the second region communicating with each other, the first region including a closed lower portion such that an electrode plat and an electrolyte are inwardly inserted, the second region including a predetermined region which is closed and protruded outwardly from the sidewall of the first region and a remaining predetermined region including an opened lower portion which allows the space formed by the first region to communicate with the space formed by the second region, and a flange prepared protruded outwardly from the upper edges of the second region, wherein the second region is larger in cross-sectional area than the first region;
 - a cap including a closed upper portion and sidewalls forming a periphery capable of enclosing the flange and assembled with the can to form a single closed container such that inner sides of the sidewalls of the cap face the outer side of the flange; and
 - an electrode terminal of which one end is connected with the electrode plate and the other end is exposed to the outside of the can.
2. The lithium ion secondary battery of claim 1, wherein the lower portion of the second region has a

predetermined region that is protruded by a length range of 2 – 10 mm from the sidewall of the first region, and the flange is protruded by a length range of 0.2 – 2 mm from the sidewall of the second region.

5

3. The lithium ion secondary battery of claim 1, wherein the periphery of the sidewalls of the cap is formed such that a clearance between the inner side of the sidewalls of the cap and the outer side of the flange is 1 mm or less if the can and the cap are located such that the inner sides of the sidewalls face the outer side of the flange.

4. The lithium ion secondary battery of claim 1, wherein a height of the sidewall of the second region is in a range of 0.5 mm to 3 mm, and a height of the sidewalls of the cap is in a range of 0.5 mm to 5 mm.

5. The lithium ion secondary battery of claim 1, wherein the other end of the electrode terminal penetrates the closed lower portion of the second region of the can to be exposed to the outside of the can.

6. The lithium ion secondary battery of claim 1 or 5, further comprising a protective circuit box provided therein with a circuit electrically connected with the electrode terminal, the protective circuit box being installed at a space formed by the outer side of the one sidewall of the first region and the outer side of the second region.

7. The lithium ion secondary battery of claim 1 or 5, further comprising a PTC box provided therein with a PTC device electrically connected with the electrode terminals, the PTC box being installed outside the sidewall of the first region
5 of the can or outside the lower portion of the second region of the can such that the PTC box is located at a space formed by an outer side of the sidewall of the first region and an outer side of the lower portion of second region, or installed at the sidewall of the first region such that the PTC box is located
10 below the flange.

8. The lithium ion secondary battery of claim 1, wherein the flange of the can is welded with the sidewall or upper side of the cap to form the closed container.

FIG.1A
(Prior Art)

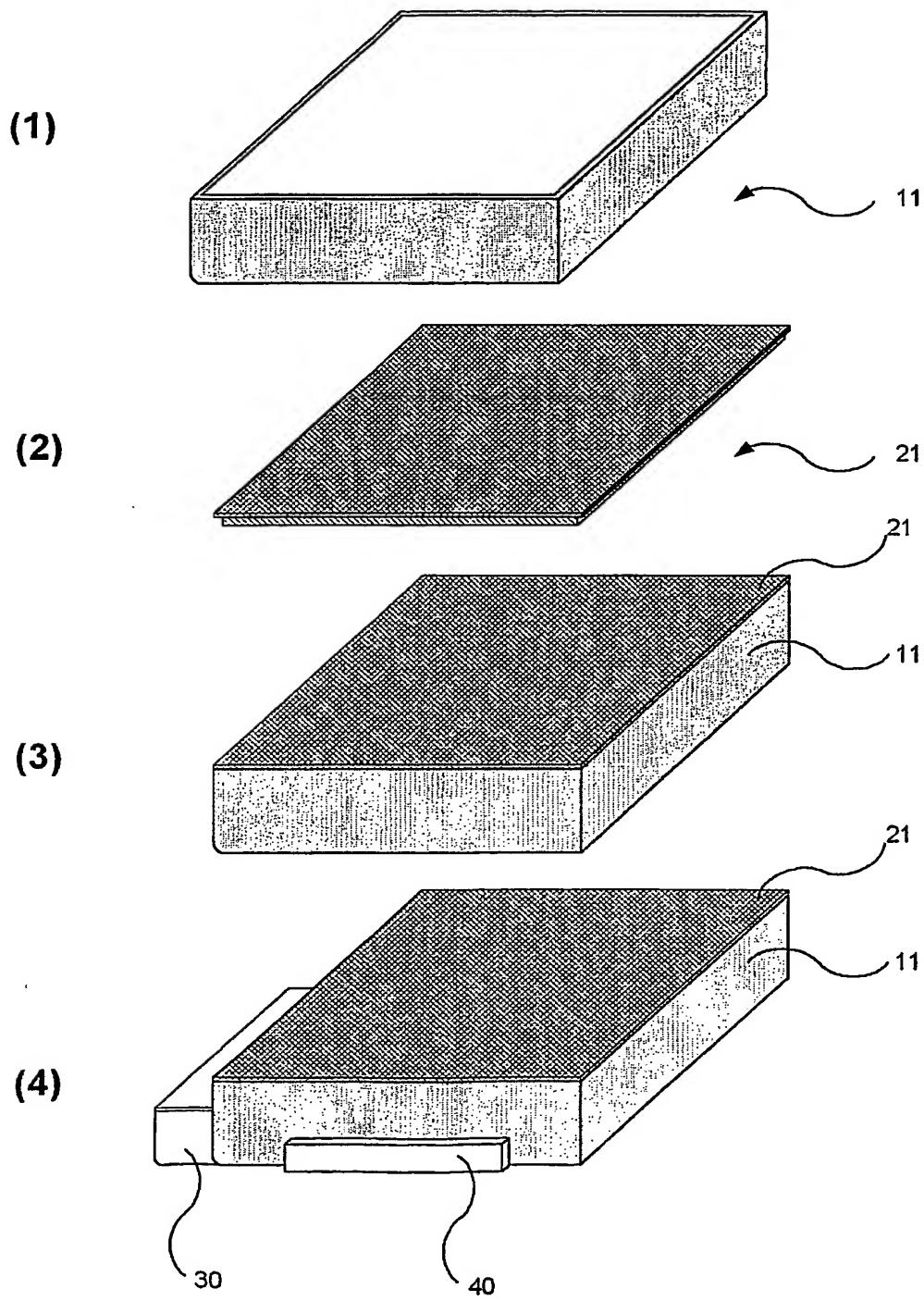
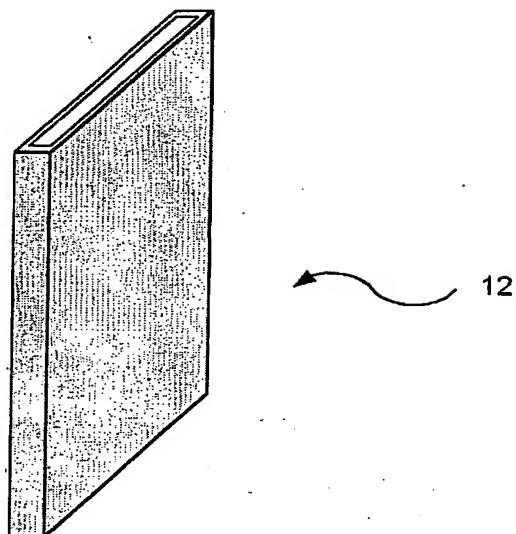
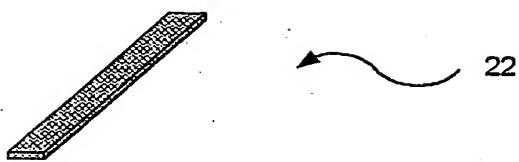


FIG.1B
(Prior Art)

(1)



(2)



(3)

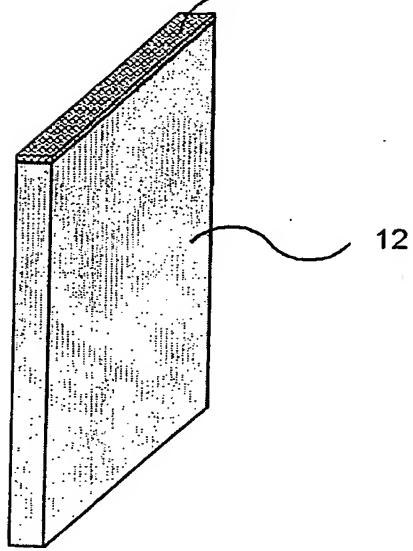


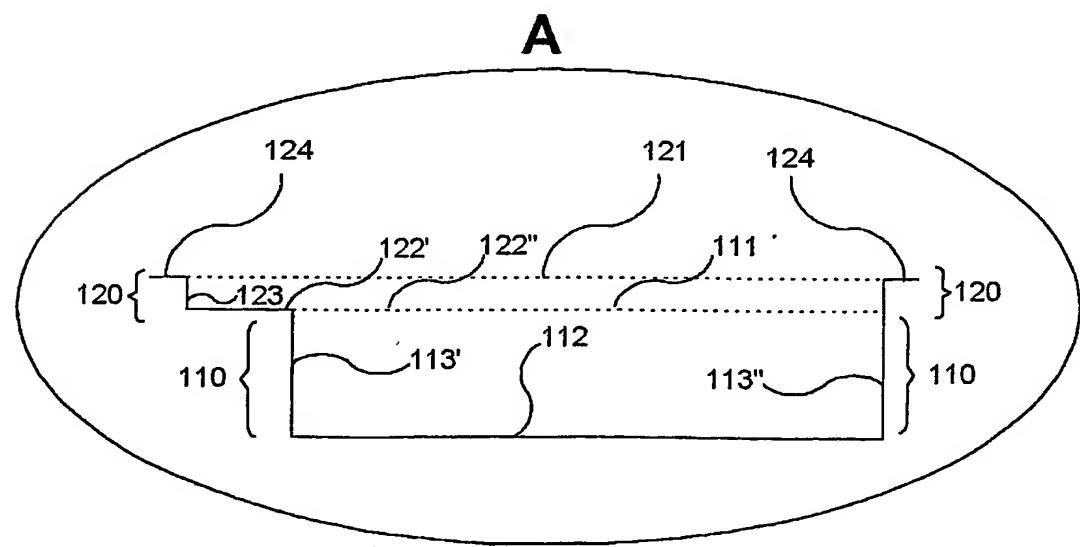
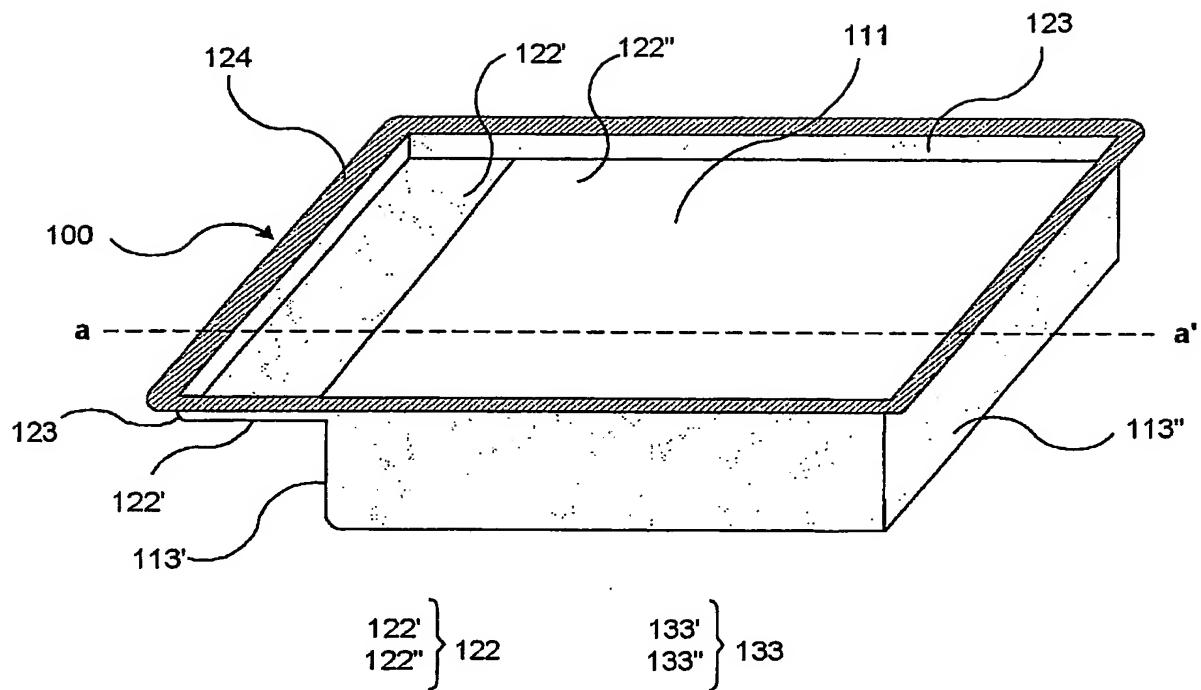
FIG.2

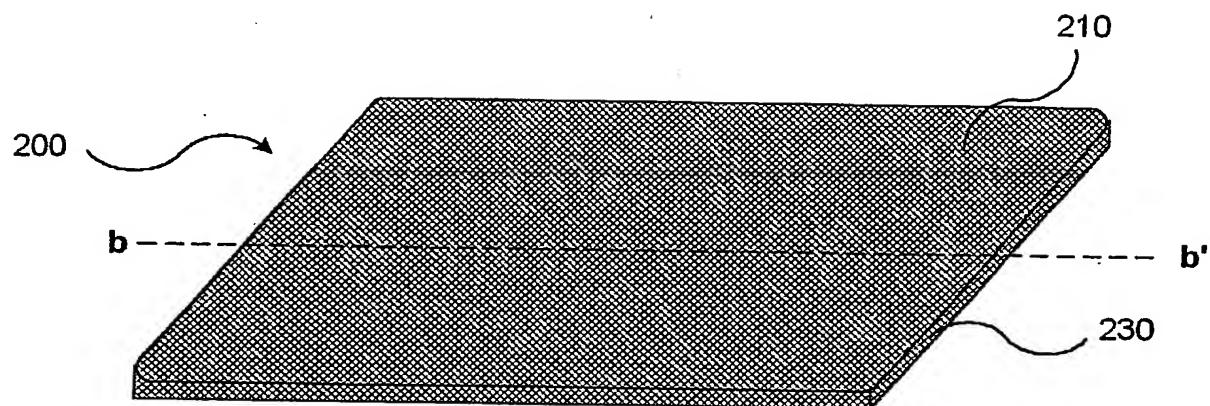
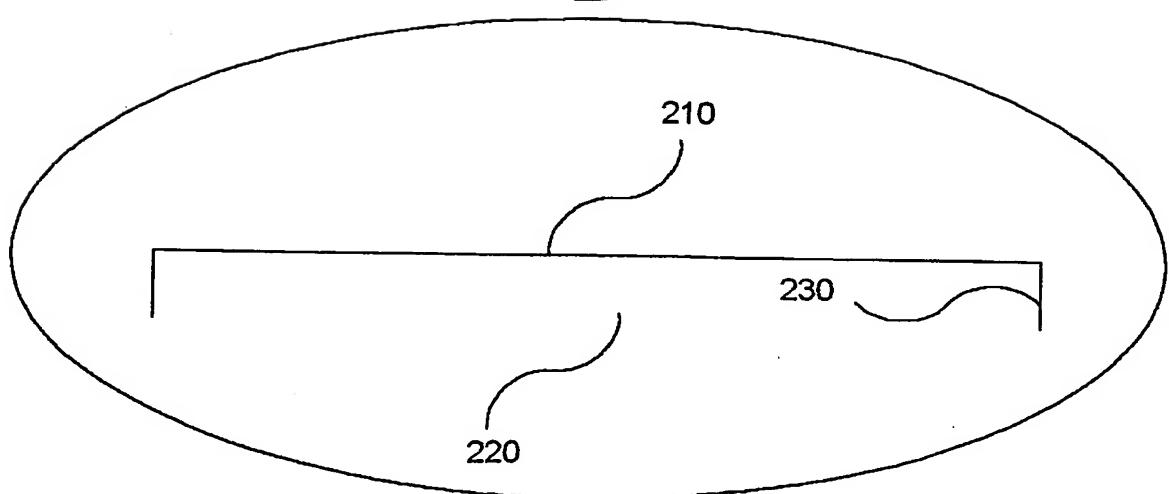
FIG.3**B**

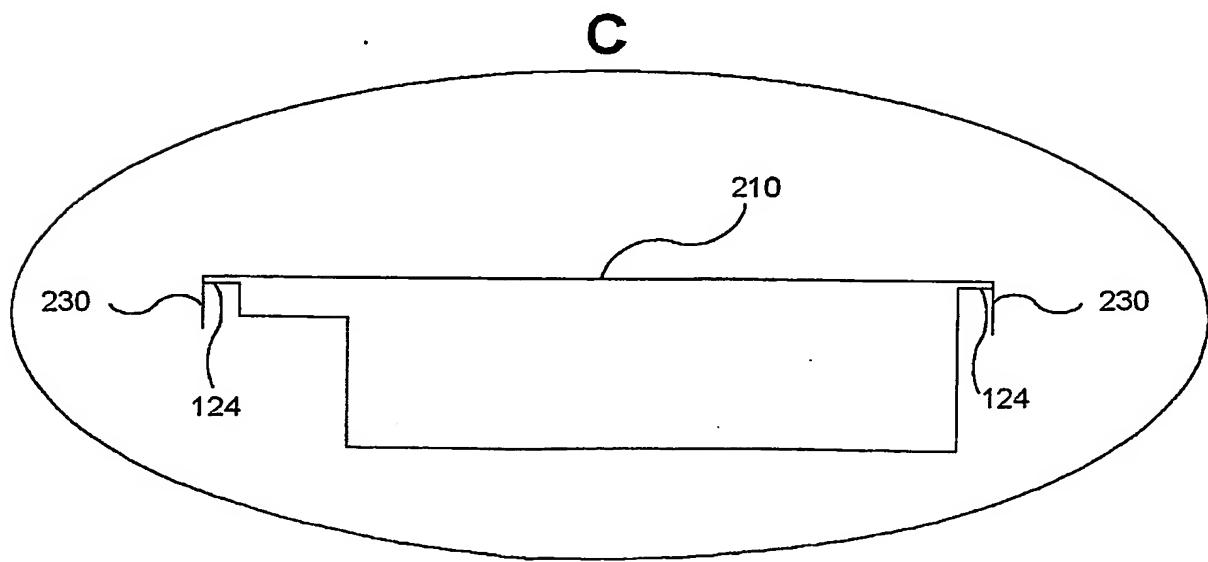
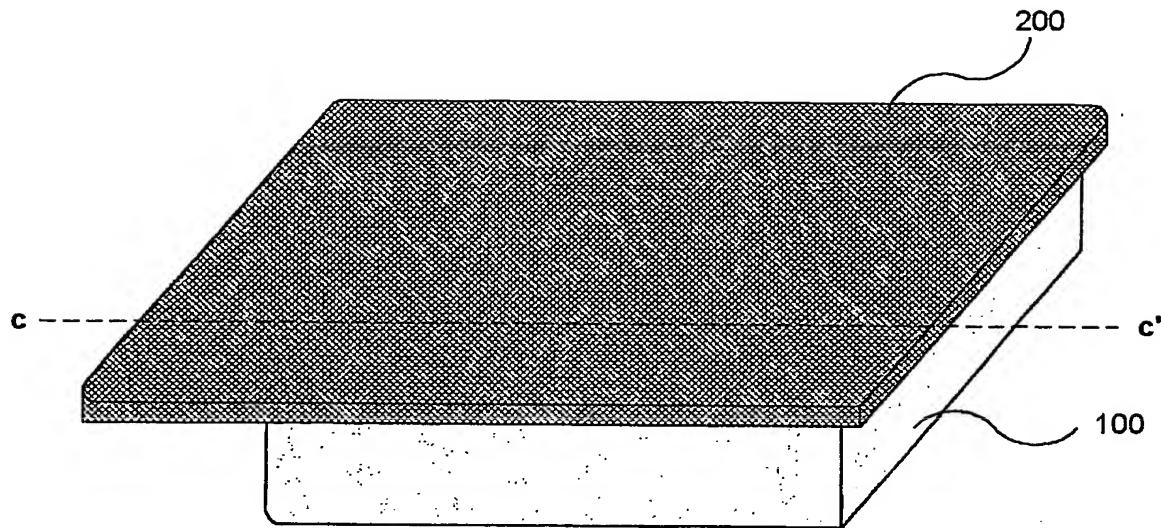
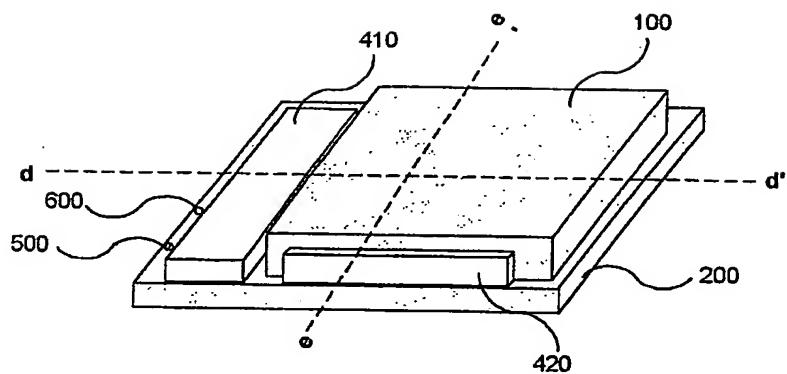
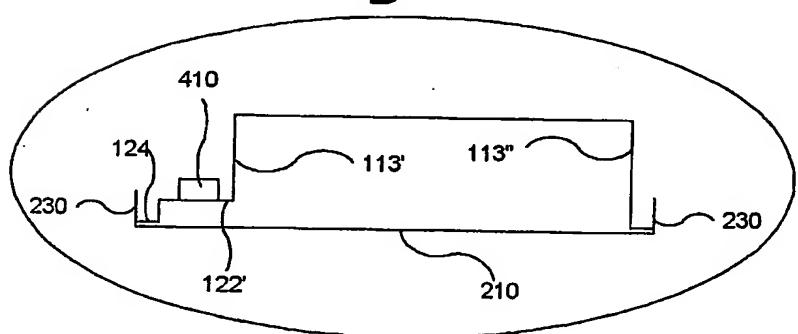
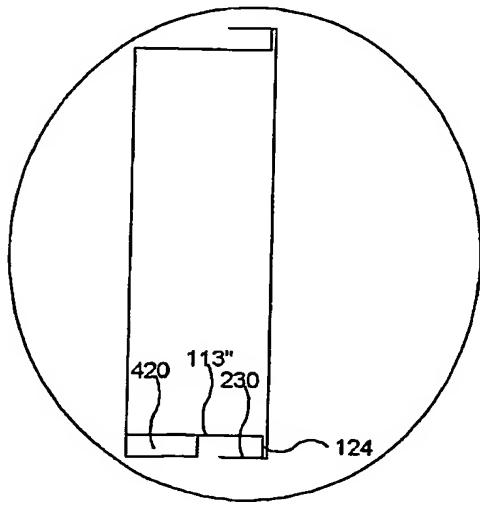
FIG.4

FIG.5**D****E**

INTERNATIONAL SEARCH REPORT

International application No.

PCT/KR02/00412

A. CLASSIFICATION OF SUBJECT MATTER

IPC7 H01M 10/04

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

H01M 2/02, H01M 2/10, H01M 10/02, H01M 10/04, H01M 10/38

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|-----------|--|-----------------------|
| A | JP 13-126686 A (TOSHIBA BATTERY CO LTD) 11 MAY 2001 | 1 - 8 |
| A | JP 10-284037 A (SANYO ELECTRIC CO LTD) 23 OCTOBER 1998 | 1 - 8 |
| A | JP 09-129195 A (MATSUSHITA ELECTRIC IND CO LTD) 16 MAY 1997 | 1 - 8 |
| A | JP 59-123163 A (MATSUSHITA ELECTIRC IND CO LTD) 16 JULY 1984 | 1 - 8 |

 Further documents are listed in the continuation of Box C. See patent family annex.

* Special categories of cited documents:

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 "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
 "&" document member of the same patent family

Date of the actual completion of the international search

28 MAY 2002 (28.05.2002)

Date of mailing of the international search report

28 MAY 2002 (28.05.2002)

Name and mailing address of the ISA/KR



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